CONTROL SOFTWARE DEVELOPMENT USING MATLAB TOOLCHAIN

MATLAB EXPO - 2019

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Agenda

- Development Challenges
  - Need of Hour
- Development Approach
  - Software Architecture
  - Concept Generation
  - Software Development
  - Testing Methods
  - Benefits
- Summary/Conclusion
Development Challenges

- Complexity
- Targets

Is there any thing to reuse
Development time
Its very complex
Unable to maintain
SW Quality??
How can I test
multiple systems
Development Challenges – Need of Hour
Front Loading Development Approach
Development Approach

Conventional MBD Workflow

System Specs

Sw Architecture

Software Development

Testing

Code Generation

.hex

.A2L
Development Approach

Integrated MBD Workflow
Development Approach

Sw Architecture

**SWC Architecture**
Architecture definition in MATLAB/SIMULINK

**Challenges**
- Quality
  - Concept Ambiguity
  - Req Elicitation
- Time
  - Architecture Def

**Solution**
- Quality
  - Deliberation
  - Cascaded
- Time
  - Modular Architecture

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Development Approach

Concept Generation

Functional Test Point & Tagging
Functionality Test Requirement (Coverage) & Tagging (Traceability)

Challenges
- Quality
  - Concept Coverage
  - Traceability
  - IO Mapping
- Time
  - Algo Def

Solution
- Quality
  - Better Coverage
  - Better Traceability
- Time
  - Robust Algo
Development Approach
Sw Development

Documentation
Automated Documentation

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Chapter 1. Component Description
SchasCtrl

Requirement ID
  Requirement ID: SchasCtrl

Model Description
This system calculates the controller output for enabling XH component.
Main components of this system are:
1. Component Enable Function
2. Pump Flow Control
3. Component: Controller
4. Discrete Signals

Table 1.2. Signals for this sub-system
<table>
<thead>
<tr>
<th>Signals</th>
<th>Signal Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>SchasCtrl::PopCmpFlowConOut</td>
<td>Output/DF1</td>
<td>Pump Flow Control</td>
</tr>
<tr>
<td>SchasCtrl::PopCmpFlowConOut</td>
<td>Output/DF1</td>
<td>Pressure Sensor</td>
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<tr>
<td>SchasCtrl::PopCmpFlowConOut</td>
<td>Output/DF1</td>
<td>Flow Rate Control</td>
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</tbody>
</table>

Challenges
Quality
• MDL Consistency
• Traceability
• Future Adaptation

Time
• Short Dev Time

Solution
Quality
• Robust Model
• Sys→ Model
• Traceability
• Modular/ Reuse

Time
• Quick Development
Development Approach

Testing Methods

Sw Development

SwC Testing

Open Loop Testing
Sw component → Functional, Coverage

SwC Dev

Test Vectors Creation

SwC Test Execution

Test Pass?

Y

N

SwC Testing Completed

SwSys Testing

SwSys Verified

Challenges

Quality
- Test Coverage
- Acceptance Criteria
- Testing Phase

Time
- Model Complexity
Development Approach

Testing Methods

**Simulink Test**

- **Sw Development**
- **SwC Testing**
- **SwSys Testing**
- **SwSys Verified**

**Test Reporting**

**Challenges**

- **Quality**
  - Test Coverage
  - Acceptance
  - Testing Phase

- **Time**
  - Model Complexity
Development Approach

Testing Methods

SwSys Testing
Closed Loop Testing
Sys Level → Functional, Non-Functional

Challenges
Quality
- Test Coverage
- Acceptance
- Testing Phase

Time
- Model Complexity

Solution
Quality
- Better Coverage
- White box/ Black box Testing

Time
- Early Reliability
- SwC/SwSys Test
Development Approach

Benefits

<table>
<thead>
<tr>
<th>Conv MBD Process</th>
<th>Development Phase</th>
<th>Integrated MBD Process</th>
<th>Time</th>
<th>QC Point</th>
<th>Time</th>
<th>QC Point</th>
<th>Time</th>
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</table>

- More QC point, better Software Quality
- Rework time is reduced by 67%.
- Higher Coverage.
- Overall Development time is reduced by 22%.
# Summary

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Approach Outcome</th>
<th>Impact Parameter</th>
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<tr>
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<td>Time</td>
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<tr>
<td>1</td>
<td>Reduced Complexity</td>
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<td>2</td>
<td>Bidirectional Traceability</td>
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<td>Higher Testing Coverage</td>
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<td>Robust Algorithm/ Model</td>
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<td>8</td>
<td>Automated Documentation</td>
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Thank You

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